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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
60096-008-PC		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US02/40107	16 December 2002 (16.12.2002)	12 April 2002 (12.04.2002)

International Patent Classification (IPC) or national classification and IPC

IPC(7): B01D 46/00; F01N 3/00, 3/023, 3/033, 3/36 and US Cl.: 55/284, 302, 303, 385.3, 428.1, 523, DIG.10, DIG.30; 60/274, 295, 296, 297, 299, 303, 311

Applicant

ILLINOIS VALLEY HOLDING COMPANY

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 12 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
12 November 2003 (12.11.2003)	11 November 2004 (11.11.2004)
Name and mailing address of the IPEA/US Mail Stop PCT, Attn: IPEA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230	Authorized officer Jason M. Greene Telephone No. (571) 272-1700

Form PCT/IPEA/409 (cover sheet)(July 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US02/40107

I. Basis of the report

1. With regard to the elements of the international application:*

☐ the international application as originally filed.

☒ the description:
pages 1-68 as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☒ the claims:
pages 72-80, 83, and 86-95, as originally filed
pages NONE, as amended (together with any statement) under Article 19
pages _____, filed with the demand
pages 69-71, 81, 82, 84, 85, and 96-100, filed with the letter of 14 June 2004 (14.06.2004)

☒ the drawings:
pages 1-27, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☐ the sequence listing part of the description:
pages NONE, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination(under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in printed form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages NONE

☐ the claims, Nos. NONE

☐ the drawings, sheets/fig NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*
*** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

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V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. STATEMENT

Novelty (N)	Claims	7,8,10-19,23-63 and 66-68	YES
	Claims	1-6, 9, 20-22, 64, and 65	NO
Inventive Step (IS)	Claims	7,8,10-19,23-63 and 66-68	YES
	Claims	1-6, 9, 20-22, 64, and 65	NO
Industrial Applicability (IA)	Claims	1-68	YES
	Claims	NONE	NO

2. CITATIONS AND EXPLANATIONS
Please See Continuation Sheet

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

V. 2. Citations and Explanations:

Claims 1, 2, 4-6, 9, and 20-22 lack novelty under PCT Article 33(2) as being anticipated by Bailey et al. (US Patent No. 6,233,926 B1).

With regard to claim 1, Bailey et al. discloses a particulate trap system for an internal combustion engine comprising at least one particulate trap (1a,1b,1c or 100) positioned to accept engine exhaust gas including a plurality of passages having porous walls for receiving the exhaust gas, wherein the porous walls filter particulate from the exhaust gas, and reversing means (11,12,13 or 103) for periodically reversing a portion of the filtered exhaust gas back through the porous walls in reverse flow at a substantially constant pressure drop, resultant flow velocity, and duration sufficient to dislodge and erode and build-up of soot and ash particles from the porous walls in Figs. 1 and 9c and col. 6, line 1 to col. 17, line 29.

With regard to clam 2, Bailey et al. discloses the at least one particulate trap module being at least one monolithic cross flow trap module having a plurality of flow passages (2) in Figs. 1 and 9c and col. 6, line 1 to col. 17, line 29.

With regard to claim 4, Bailey et al. discloses the particulate trap system including an entrance chamber (102) for receiving the exhaust gas from the engine and operatively connected to a first side of the at least one particulate trap module, a separation chamber (105) operatively attached to a second side of the at least one particulate trap module and for receiving some of the exhaust gas from the at least one particulate trap module, and an exit chamber (not numbered, chamber containing filter module 100) for receiving the filtered exhaust gas passing through the porous wall of the at least one particulate trap in Fig. 9c and col. 14, line 57 to col. 17, line 29.

With regard to claims 5, 6, and 9, Bailey et al. discloses the particulate trap system including means (118) for creating a pressure difference between the separation chamber and the exit chamber in response to a pre-established engine operating condition, wherein the pressure in the exit chamber is greater than the pressure in the separation chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls, wherein the means for creating the pressure difference is a pressure relief valve (118) operatively mounted to the exit chamber for creating pressure build-up in the exit chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on the inner surfaces of the porous walls, the particulate trap system further including at least one exit valve (103) to selectively allow exhaust gas to flow through the through flow passages to blow out the removed soot and ash and to erode any additional soot and ash in Fig. 9c and col. 14, line 57 to col. 17, line 29.

With regard to claim 20, Bailey et al. discloses the particulate trap system including a sole rotary valve (103) having an aperture and face plate and rotatably mounted to a single particulate trap module between the through flow passages and the separation chamber, wherein exhaust gas is allowed to flow through the aperture to the separation chamber and precluded from flowing from the through flow passages to the separation chamber via the face plate, means (104) for rotating the sole rotary valve, wherein exhaust gas

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(To be used when the space in any of the preceding boxes is not sufficient)

entering the through flow passages plugged by the face plate is filtered through the porous walls (3), wherein when the means (118) for creating a pressure difference between the separation chamber and the exit chamber in response to the pre-established engine operating condition is started and the pressure in the exit chamber will be greater than the pressure in the separation chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the through flow passages of the porous walls open via the aperture to the separation chamber to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls while simultaneously receiving a high velocity of exhaust gas through flow from the entrance chamber to the separation chamber to erode and blow out the soot and ash, and wherein the exhaust gas entering the through flow passages and exiting into the separation chamber via the aperture is filtered through a secondary filter (106) in Fig. 9c and col. 14, line 57 to col. 17, line 29.

With regard to claims 21 and 22, Bailey et al. discloses the particulate trap system including a porous ceramic secondary filter (106) operatively connected to the separation chamber for filtering exhaust gas in the separation chamber release into the atmosphere, and a remote energized three-way rotary valve (114) operatively connected to the separation chamber and operatively connected to a high pressure source (116) for supplying a burst of high pressure air to the secondary filter in reverse flow to dislodge any build up of soot and ash in the secondary filter in response to the pre-established engine operating condition in Fig. 9c and col. 14, line 57 to col. 17, line 29.

Claims 1 and 3 lack novelty under PCT Article 33(2) as being anticipated by Watanabe et al. (US Patent No. 5,930,995).

With regard to claim 1, Watanabe et al. discloses a particulate trap system for an internal combustion engine comprising at least one particulate trap (42-45) positioned to accept engine exhaust gas including a plurality of passages having porous walls for receiving the exhaust gas, wherein the porous walls filter particulate from the exhaust gas, and means (52-54, 72-74, and 80) for periodically reversing a portion of the filtered exhaust gas back through the porous walls in reverse flow at sufficient pressure drop and resultant flow velocity to dislodge and erode and build-up of soot and ash particles from the porous walls in Figs. 4-8 and col. 5, line 17 to col. 8, line 18.

With regard to claim 3, Watanabe et al. discloses the at least one monolithic particulate trap being at least one wall flow trap module in Figs. 4-8 and col. 3, lines 51-64.

Claims 1 and 3 lack novelty under PCT Article 33(2) as being anticipated by Japanese Published Patent Application JP 4-31613.

With regard to claim 1, JP 4-31613 discloses a particulate trap system for an internal combustion engine comprising at least one particulate trap (51) positioned to accept engine exhaust gas including a plurality of passages having porous walls for receiving the exhaust gas, wherein the porous walls filter particulate from the exhaust gas, and reversing means (54,58) for periodically reversing a portion of the filtered exhaust gas back through the porous walls in reverse flow at a substantially constant pressure drop, resultant flow velocity, and duration to dislodge and erode and build-up of soot and ash particles from the porous walls in Fig. 1.

With regard to claim 3, JP 4-31613 discloses the at least one particulate trap being at least one wall flow trap module in Fig. 1.

Claim 2 lacks an inventive step under PCT Article 33(3) as being obvious over Watanabe et al. (US Patent No. 6,233,926 B1) or Japanese Published Patent Application JP 4-31613 in view of Oda et al. (US Patent No. 4,833,883).

Watanabe et al. and JP 4-31613 do not disclose the at least one particulate trap module being at least one monolithic cross flow trap module having a plurality of through flow passages.

Oda et al. discloses a similar system having at least one monolithic cross flow trap module having a plurality of through flow passages in Figs. 3 and 4 and col. 5, line 30 to col. 6, line 53.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the cross flow trap module of Oda et al. into the systems of Watanabe et al. and JP 4-31613 to provide a compact particulate trap requiring only a small installation space, as suggested by Oda et al. in col. 3, lines 41-44.

Claims 7, 8, and10 meet the criteria set forth in PCT Articles 33(2)-(3) because the prior art made of record does not teach or fairly suggest the system of claim 5 wherein the means for creating the pressure difference between the separation chamber and the exit chamber is a venturi operably connected to the separation chamber.

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Claims 11-19 meet the criteria set forth in PCT Articles 33(2)-(3) because the prior art made of record does not teach or fairly suggest the system of claim 5 having the specific valve arrangement recited in claims 11, 14, or 19.

With regard to claim 23, Bailey et al. discloses the particulate trap system including a refractory fabric secondary filter for filtering the exhaust gas in the separating chamber before release into the atmosphere, and an exit passageway (108) operatively connected subsequent to the secondary filter of the separation chamber for directing the filtered exhaust gas passing through the secondary filter to the atmosphere in Fig. 9c and col. 14, line 57 to col. 17, line 29.

Claim 23 meets the criteria set forth in PCT Articles 33(2)-(3) because the prior art made of record does not teach or fairly suggest the system of claim 23 wherein the secondary filter includes a convoluted perforated metal support plate, wherein the convoluted metal support plate limits the flexing of the refractory fabric secondary filter and allows some flexing to break up accumulated soot and ash.

Claims 24-32 meet the criteria set forth in PCT Articles 33(2)-(3) because the prior art made of record does not teach or fairly suggest the system of claim 3 including a first small flow entrance chamber, a first large flow entrance chamber, a plurality of moveable cylindrical slide valves, a second small flow entrance chamber, and a second large flow entrance chamber as specifically recited in claim 24.

Claims 33-38 meet the criteria set forth in PCT Articles 33(2)-(3) because the prior art made of record does not teach or fairly suggest the system of claim 3 including a first small flow entrance chamber, a first large flow entrance chamber, and a plurality of poppet valves as specifically recited in claim 33.

With regard to claims 39-63, 66 and 68, Bailey et al. discloses a particulate trap system for an internal combustion engine comprising at least one particulate trap module (11) to accept engine exhaust gas including a plurality of passages having porous walls for filtering exhaust gas, the porous walls having inner surfaces coated with precious metal catalysts, means for passing the exhaust gas through the porous walls of a majority of the plurality of passages, the porous walls removing particulates and oxidizing the particulates via precious metal catalysts at an acceptable temperature range.

Claims 39-63,66 and 68 meet the criteria set forth in PCT Articles 33(2)-(3) because the prior art made of record does not teach or fairly suggest the system of claims 39, 60, or 66 having a nitrogen oxide (NOx) reduction aftertreatment system and including means for converting NOx to NO_2 in the plurality of passages via the precious metal catalyst at the acceptable temperature range, means for storing the NO_2 in the NOx adsorber material at the acceptable temperature range, and means for adding fuel to a minority flow of the exhaust gas to convert it to a rich mixture and for passing the minority flow of exhaust gas through a minority of the plurality of passages, thereby causing the rich mixture of exhaust gas flow to release the stored NO_2 for reduction by CO in the rich mixture flow of exhaust gas in the presence of precious metal catalyst at the acceptable temperature range forming CO_2 and N_2.

Claims 64 and 65 lack novelty under PCT Article 33(2) as being anticipated by Bailey et al. (US Patent No. 6,233,926 B1).

Bailey et al. discloses a method for filtering and regenerating particulate trap system for an internal combustion engine comprising positioning an at least one particulate trap module (100) to accept engine exhaust gas, wherein the at least one particulate trap module has a plurality of passages (2) having porous walls (3) for receiving exhaust gas, filtering the exhaust gas via the porous walls, and periodically reversing a portion of the filtered exhaust gas back through the porous walls in reverse flow at sufficient flow velocity to dislodge and erode any build-up of soot and ash from the porous walls, and further including creating a pressure difference between the separation chamber (105) and the exit chamber (not numbered, chamber containing particulate trap module 100) in response to a pre-established engine operating condition, wherein the pressure in the exit chamber is greater than the pressure in the separation chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls in Fig. 9c and col. 14, line 57 to col. 17, line 29.

Claims 64 and 65 lack novelty under PCT Article 33(2) as being anticipated by Watanabe et al. (US Patent No. 5,930,995).

Watanabe et al. discloses a method for filtering and regenerating particulate trap system for an internal combustion engine comprising positioning an at least one particulate trap module (42-45) to accept engine exhaust gas, wherein the at least one particulate trap module has a plurality of passages having porous walls for receiving exhaust gas, filtering the exhaust gas via the porous walls, and periodically reversing a portion of the filtered exhaust gas back through the porous walls in reverse flow at sufficient flow velocity to dislodge and erode any build-up of soot and ash from the porous walls, and further including creating a pressure difference between a

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(To be used when the space in any of the preceding boxes is not sufficient)

separation chamber (22b-25b) and an exit chamber (21) in response to a pre-established engine operating condition, wherein the pressure in the exit chamber is greater than the pressure in the separation chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls in Figs. 4-8 and col. 5, line 17 to col. 8, line 18.

Claims 64 and 65 lack novelty under PCT Article 33(2) as being anticipated by Japanese Published Patent Application JP 4-31613.

JP 4-31613 discloses a method for filtering and regenerating particulate trap system for an internal combustion engine comprising positioning an at least one particulate trap module (51) to accept engine exhaust gas, wherein the at least one particulate trap module has a plurality of passages having porous walls for receiving exhaust gas, filtering the exhaust gas via the porous walls, and periodically reversing a portion of the filtered exhaust gas back through the porous walls in reverse flow at sufficient flow velocity to dislodge and erode any build-up of soot and ash from the porous walls, and further including creating a pressure difference between a separation chamber (not numbered, upstream of trap 51) and an exit chamber (not numbered, downstream of trap 51) in response to a pre-established engine operating condition, wherein the pressure in the exit chamber is greater than the pressure in the separation chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls in Fig. 1.

Claim 67 meets the criteria set forth in PCT Articles 33(2)-(3) because the prior art made of record does not teach or fairly suggest the system of claim 3 further including a rotary valve means for preventing exhaust gas entry into a minority of the passages and for connecting an entrance of the minority of the passages to a separation chamber, wherein the rotary valve rotates to sequentially cause reverse flow through the porous walls of each of the minority of the passages while permitting normal flow to continue through the porous walls of the majority of the trap passages.

Claims 1-68 meet the criteria set forth in PCT Article 33(4) because the invention can be made and used in industry.

What is claimed is:

1. A particulate trap system for an internal combustion engine, comprising:

at least one particulate trap module positioned to accept engine exhaust gas including a plurality of passages having porous walls for receiving the exhaust gas, wherein the porous walls filter particulate from the exhaust gas; and

reversing means for periodically reversing a portion of the filtered exhaust gas back through the porous walls in reverse flow at a substantially constant pressure drop, resultant flow velocity, and duration sufficient to dislodge and erode any build-up of soot and ash from the porous walls.

2. The particulate trap system according to claim 1, wherein the at least one particulate trap module is at least one monolithic cross flow trap module having a plurality of through flow passages.

3. The particulate trap system according to claim 1, wherein the at least one particulate trap module is at least one wall flow trap module.

4. The particulate trap system according to claim 2, further including:

an entrance chamber for receiving the exhaust gas from the engine and operatively connected to a first side of the at least one particulate trap module;

a separation chamber operatively attached to a second side of the at least one particulate trap module and for receiving some of the exhaust gas from the at least one particulate trap module; and

an exit chamber for receiving the filtered exhaust gas passing through the porous walls of the at least one particulate trap.

5. The particulate trap system according to claim 4, further including:

means for creating a pressure difference between the separation chamber and the exit chamber in response to a pre-established engine operating condition, wherein the pressure in the exit chamber is greater than the pressure in the separation chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls.

6. The particulate trap system according to claim 5, wherein the means for creating the pressure difference between the separation chamber and the exit chamber is a pressure relief valve associated with the exit chamber for creating pressure build-up in the exit chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on the inner surfaces of the porous walls.

7. The particulate trap system according to claim 5, wherein the means for creating the pressure difference between the separation chamber and the exit chamber is a venturi associated with the exit chamber and operatively connected to the separation chamber, wherein the venturi increases pressure in the exit chamber and reduces the pressure in the

separation chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on the inner surfaces of the porous walls.

8. The particulate trap system according to claim 5, wherein the means for creating the pressure difference between the separation chamber and the exit chamber is a pressure relief valve associated with the exit chamber valve for creating pressure build-up in the exit chamber, and a venturi associated with the exit chamber and operatively connected to the separation chamber, wherein the venturi increases pressure in the exit chamber and reduces the pressure in the separation chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on the inner surfaces of the porous walls.

9. The particulate trap system according to claim 5, further including at least one exit valve to selectively allow exhaust gas to flow through the through flow passages to blow out the removed soot and ash and to erode any additional soot and ash.

10. The particulate trap system according to claim 9, further including:

an igniter for burning the soot; and

a chamber for storing the ash.

11. The particulate trap system according to claim 5, further including:

the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls back through the first small flow entrance chamber.

27. The particulate trap system according to claim 26, wherein the means for creating the pressure difference between the exit chamber and the second small flow entrance chamber is a pressure relief valve associated with the exit chamber and for creating pressure build-up in the exit chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on the inner surfaces of the porous walls back through the first small flow entrance chamber.

28. The particulate trap system according to claim 26, wherein the means for creating the pressure difference between the exit chamber and the second small flow entrance chamber is a venturi associated with the exit chamber and operatively connected to the second small flow entrance chamber, wherein the venturi increases pressure in the exit chamber and creates a suction in the second small flow entrance chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on the inner surfaces of the porous walls back through the first small flow entrance chamber.

29. The particulate trap system according to claim 26, wherein the means for creating the pressure difference between the exit chamber and the second small flow entrance chamber is a venturi associated with the exit chamber and operatively connected to the secondary filter, wherein the venturi increases pressure in the exit chamber and creates a suction in the

second small flow entrance chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on the inner surfaces of the porous walls back through the first small flow entrance chamber.

30. The particulate trap system according to claim 26, wherein the means for creating the pressure difference between the exit chamber and the second small flow entrance chamber is a pressure relief valve associated with the exit chamber and for creating a pressure build-up in the second small flow entrance chamber, and a venturi associated with the exit chamber and operatively connected to the second small flow entrance chamber, wherein the venturi increases pressure in the exit chamber and creates a suction in the second small flow entrance chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls.

31. The particulate trap system according to claim 25, wherein the apertures of one of the cylindrical valves is aligned with the tube apertures of one of the tubes between the first small flow entrance chamber and the second small flow entrance chamber to allow exhaust gas to pass to one of the particulate trap modules for filtering through the porous walls, and the apertures of the remaining cylindrical valves are aligned with the tube apertures of the remaining tubes between the first large flow entrance chamber and the second large flow entrance chamber to allow exhaust gas to pass to the remaining particulate trap modules for filtering through the porous walls, and wherein the exhaust gas passes from the particulate trap modules into the exit chamber for release into the atmosphere.

34. The particulate trap system according to claim 33, further including:

means for actuating the poppet valve from the first position to the second position and from the second position to the first position, wherein one of the poppet valves is moved into the second position for receiving filtered exhaust gas back flow through the porous walls from the exit chamber; and

means for sequentially dislodging and blowing out the build-up of soot and ash for each of the at least one particulate trap modules in response to the pre-established engine operating condition, wherein one of the at least one particulate trap modules receives the back flow of exhaust gas from the exit chamber.

35. The particulate trap system according to claim 34, further including:

means for creating a pressure difference between the exit chamber and the second small flow entrance chamber in response to a pre-established engine operating condition, wherein the pressure in the exit chamber is greater than the pressure in the second small flow entrance chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls back through the first small flow entrance chamber.

36. The particulate trap system according to claim 35, wherein the means for creating the pressure difference between the exit chamber and the second small flow entrance chamber is a pressure relief valve associated with the exit chamber and for creating pressure build-up in the exit chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and

ash on the inner surfaces of the porous walls back through the first small flow entrance chamber.

37. The particulate trap system according to claim 35, wherein the means for creating the pressure difference between the exit chamber and the second small flow entrance chamber is a venturi associated with the exit chamber and operatively connected to the second small flow entrance chamber, wherein the venturi increases pressure in the exit chamber and creates a suction in the second small flow entrance chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on the inner surfaces of the porous walls back through the first small flow entrance chamber.

38. The particulate trap system according to claim 35, wherein the means for creating the pressure difference between the exit chamber and the second small flow entrance chamber is a pressure relief valve associated with the exit chamber and for creating a pressure build-up in the second small flow entrance chamber, and a venturi associated with the exit chamber and operatively connected to the second small flow entrance chamber, wherein the venturi increases pressure in the exit chamber and reduces pressure in the second small flow entrance chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls.

39. A particulate trap system for an internal combustion engine having a nitrogen oxide (NOx) reduction aftertreatment system, comprising:

at least one particulate trap module to accept engine exhaust gas including a plurality of passages having porous walls for filtering exhaust gas,

oxidizing the particulate via the precious metal catalysts at an acceptable temperature range;

converting NOx to NO_2 in the plurality of passages via the precious metal catalyst;

storing the NO_2 in the NOx adsorber material;

adding fuel to a minority flow of the exhaust gas to convert it to a rich mixture; and

passing the minority flow of exhaust gas through a minority of the plurality of passages, thereby causing the rich mixture of exhaust gas flow to release stored NO_2 for reduction by CO in the rich mixture flow of exhaust gas in the presence of precious metal catalyst at the acceptable temperature range forming CO_2 and N_2.

61. The method for reducing nitrogen oxide (NOx) in a cross flow particulate trap system used with an internal combustion engine according to claim 60, further including the steps of:

aligning a first, normal lean exhaust gas entrance chamber with a first end of the through flow passages;

aligning a second, rich exhaust entrance chamber with a second end of the through flow passages;

filtering exhaust gas through the porous walls of the through flow passages;

collecting the filtered exhaust gas in a third, exit chamber;

directing the exhaust gas from the third, exit chamber to the atmosphere;

admitting a majority of the normal lean exhaust gas from the first normal lean exhaust chamber into the first end of the through flow passages for a period of time, and blocking a minority of the normal lean exhaust gas

from the first normal lean exhaust chamber into the first end of the through flow passages for a majority of the time;

admitting a minority of rich exhaust gas from the second rich exhaust chamber into the second end of the through flow passages for a period of time;

blocking a majority of rich exhaust gas from the second rich exhaust chamber into the second end of said through flow passages for a minority of the time;

controlling the at least one first valve to allow normal lean exhaust gas to enter the first end of the majority of passages having porous walls, while precluding the rich exhaust gas from entering second end of the majority of passages;

allowing rich exhaust gas into the second ends of the minority of passages, while precluding the normal lean exhaust gas from entering the first ends of the minority of the passages; and

sequentially changing the passages receiving the normal lean exhaust gas and the rich exhaust gas flow.

62. The method for reducing nitrogen oxide (NOx) in a particulate trap system used with an internal combustion engine according to claim 60, further including the steps of:

treating the entering exhaust gas upstream of the particulate trap system;

cooling the exhaust gas stream when a maximum temperature is exceeded;

directing the majority of the exhaust gas flow to the particulate trap system to be admitted to the passages as normal lean exhaust;

directing and controlling the minority of the exhaust gas flow to an enrichment device;

injecting fuel into the minority exhaust flow stream;

igniting the injected fuel;

sensing the oxygen level downstream of the fuel injector;

monitoring and controlling at a stoichiometric to slightly rich mixture;

monitoring and controlling the temperature of the minority exhaust gas stream via the amount of fuel injected; and

directing the enriched minority exhaust flow to the passages as rich exhaust gas to the particulate trap system.

63. The method for reducing nitrogen oxide (NOx) in a particulate trap system having the at least one wall flow particulate trap used with an internal combustion engine according to claim 60, further including the steps of:

forcing exhaust gas through the porous walls coated with precious metal catalysts and NOx adsorber material of the wall flow particulate trap module;

directing a majority flow of lean exhaust gas from the engine to the vicinity of the at least one wall flow particulate trap module;

directing a minority flow of exhaust gas to the vicinity of the at least one wall flow particulate trap module;

collecting the filtered and purified exhaust gas from the at least one wall flow particulate trap module and releasing it to the atmosphere;

connecting the entrance end of the at least one wall flow particulate trap module to the first channel to admit lean exhaust gas;

connecting the entrance end of the at least one wall flow particulate trap module to the first channel to admit rich exhaust gas; and

sequentially changing the passages receiving the lean exhaust gas and the rich exhaust gas flow.

64. A method for filtering and regenerating particulate trap system for an internal combustion engine, comprising:

positioning an at least one particulate trap module to accept engine exhaust gas, wherein the at least one particulate trap module has a plurality of passages having porous walls for receiving the exhaust gas;

filtering the exhaust gas via the porous walls; and

periodically reversing a portion of the filtered exhaust gas back through the porous walls in reverse flow at a substantially constant pressure drop, resultant flow and duration sufficient to dislodge and erode any build-up of soot and ash from the porous walls.

65. The method for filtering and regenerating particulate trap system for an internal combustion engine according to claim 64, further including the steps of:

creating a pressure difference between the separation chamber and the exit chamber in response to a pre-established engine operating condition, wherein the pressure in the exit chamber is greater than the pressure in the separation chamber, thereby forcing the filtered exhaust gas from the exit chamber back through the porous walls to dislodge and blow out the build-up of soot and ash on inner surfaces of the porous walls.

66. A method for filtering and regenerating a particulate trap system for an internal combustion engine having a nitrogen oxide (NOx) reduction aftertreatment system, comprising:

accepting engine exhaust gas via an at least one particulate trap module having a plurality of passages having porous walls for filtering exhaust gas, wherein the passages have porous walls with inner surfaces coated with precious metal catalysts and NOx adsorber material;

passing a majority of lean exhaust gas through the porous walls of a majority of the plurality of passages;

removing the particulate via the porous walls and oxidizing the particulate via the precious metal catalysts at an acceptable temperature range;

converting NOx to NO_2 in the plurality of passages via the precious metal catalyst at an acceptable temperature range;

storing the NO_2 in the NOx adsorber material at the acceptable temperature range; and

adding fuel to a minority flow of the exhaust gas to convert it to a rich mixture and for passing the minority flow of exhaust gas through a minority of the plurality of passages, thereby causing the rich mixture of exhaust gas flow to release the stored NO_2 for reduction by CO in the rich mixture flow of exhaust gas in the presence of precious metal catalyst at the acceptable temperature range forming CO_2 and N_2.

67. The particulate trap system according to claim 3, further including:

rotary valve means for preventing exhaust gas entry into a minority of the passages and for connecting an entrance of the minority of the passages to a separation chamber, wherein the rotary valve rotates to sequentially cause reverse flow through the porous walls of each of the minority of the passages while permitting normal flow to continue through the porous walls of a majority of the trap passages.

68. The particulate trap system according to claim 39, wherein the means for passing a majority of lean exhaust gas through the porous of a majority of the plurality of passages includes rotary valve means for preventing exhaust gas entry into a minority of the passages and for connecting an entrance of the minority of the passages to a separation chamber, wherein the rotary valve rotates to sequentially cause reverse flow through the porous walls of each of the minority of the passages while permitting normal flow to continue through the porous walls of a majority of the trap passages.